Evolution of Internet of Things (IOT) & Its impact on Smart Agriculture Environment

Usha K.P.[1,] Dr.D.G.Anand[2], Dr. H.G. Chandrakanth[3]
{[1]ushakp@aitckm.in, [2]dga.ece.rgit@gmail.com, [3]ckgowda@hotmail.com}

[1] Research Scholar, AIT, Chikmagalur,
[2] Professor & Rector-Research, Rajiv Gandhi Institute of Technology, Bangalore,
[3] Principal, Sambram Institute of Technology, Bangalore, Karnataka,
Visvesvaraya Technological University, Belagavi, Karnataka

Abstract. In the present world scenario, due to global warming and abnormal climate changes there is challenging situation in field of agriculture. This field of Agriculture is the backbone of the Indian economy. The development of agriculture sector in terms of area of land under cultivation, use of modern equipment's with technology and financial assistance to the grower is absolutely very essential. Numbers of updates in the real-time technologies are coming in agriculture to reduce the production cost and also to improve total productivity. Water is a very important resource in agriculture. We need to focus on new concept to monitor the usage water, manure & human intervention in modern agriculture i.e. Soil testing, Humidity and water regulations etc. The development in Wireless Sensor Networks, the technology made it possible to use it in monitoring agriculture requirements in rural India. In this paper we are focusing mainly on the measurement & monitoring of various parameters like soil moisture, water supply along with humidity and temperature using wireless sensor nodes through internet.

Keywords: Measuring temperature, humidity, and controlling water supply, wireless sensor network, modern agriculture.

1 Introduction

The rapid developments of IOT based system redesigned the agriculture environment from the existing ,traditional methods and creating new avenues to study this field in both qualitative and quantitative approaches [1, 2]. This drastic, developments and recent study in blending of agriculture technology with IOT could improve in the field of agriculture sector, thereby increase in the production with reduced man power and land usage [3-7]

The goal is to confront an upcoming technology with one of the important problem across the globe, the sustainability of farming for farmers living especially in rural area. As the rain water is not not uniform throughout the season and unpredictable situation , the growers find it difficult in monitoring. At present, we do not have any designated irrigation method. Inview of this based on the received data's of from various location and its dynamics, minerals in the soil, season of rain, quantum of rain, climatic condition the type of crops to be cultivated may be decided. By this, crop yielding can be increased with lesser labor along with minimum usage of water.
Acute shortage of water across the globe is expected as the population is increasing ,deforestation with global warming. This is leading to shortage of cleaned drinking water in and aroung 1.1 billion people.In the present scenario, with the increasing population & ground water level is decreasing, the proper utilization of water is our prime objective. In this context, an correct water management approach, fertilizer, minerals feeding & multiple crop growing to avoid wastes can mitigate the above mentioned effects.

International Centre for soil Fertility and agricultural Development(IFDC), reported that cautions the formers, the limitations in type of farming practices such as usage of fertilizers (Manures), the declining status of soil nutrients at an annual rate of 30 Kg /ha in more than 75 % of African land. Formers must cultivate more and more land only to grow by cutting forest in turn because of deforestation, worsen soil erosion and that if erosion rates is not stopped, the yield of some crops could reduce by 1730% by 2025. It also suggests the need for monitoring using a Wireless Sensor Network. In our country ,formers depends mainly on traditional seasonal crops. These seasonal crops depends on unpredictable monsoon and floods which are causing damage to the small growers.

1.1 Statement of Problem

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As per the World Health Organization (WHO), the world is expecting the food production growth by 50% by 2025. This motivates the usage of modern technologies in all stages of food production, processing & preservation including transportation system, intern seed to consumer.
It is observed that farmers follow old traditional method of growing crops. The climatic condition is unpredictable. Sometimes formers undergo financial losses due to heavy rain fall or draught. In this paper, we are presenting a system with the recently developed IOT, which can be incorporated to monitor the crops using wireless sensor devices, in the automated environment. The IOT based precision farming system is will be studied to manage the system so as to improve the function with reduced water and human interference with higher productivity and profitability.

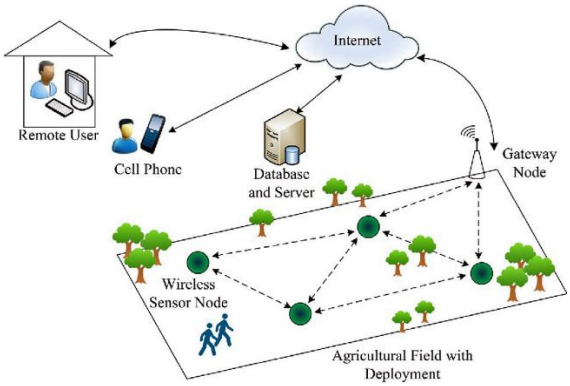

Figure 1. IOT based agriculture field

2. Related Work

The author [7], studied the agro climate in the US for studying the usage of WSN in agriculture. They noticed that distant sensing motes exhibited performance loss because of longer distance while shorter distant motes performed better.

In [8], authors presented a centralized database system, which can monitor climatic condition like rain fall, weather & status of moisture in the soil using wireless sensing motes.

The wireless sensors were deployed on selected locations and coordinates of these locations were collected with Global Position System and then, based on the collected data's were studied using the Geographic Information System [9].

The proposed system is capable of monitoring and analysis for precision water monitoring in agricultural system using zigbee and employed internet server with GPRS [10] & The author [11] developed a prototype purely for lab application for distant soil , temperature wireless measurement with13.56 MHz RFID tag which exhibited around 99% accuracy with the available thermo coupler .

2.1. Precision Agriculture

In late 90s , due to the developement of wireless sensing tecnology and its applications , the researchers and scientists made it possible to employ the development in this field in agriculture sector to help agriculture sector to improve the efficiency in productivity and reduced manpower

The IOT based precision agriculture provides real-time information about the field, through which the formers can predict or the decision about the crop can be decided based on the expected rainfall, present mineral condition of the soil along with the pricing condition in the market. The realtime based decision taking data analytics improved & yielded better approach and result than the hypothetical traditional decision making [12-14]

2.2 Wireless Sensor Network (WSN) Requirements

This WSN consists of sensing nodes deployed across the identified field. These sensor are a typical transceivers, which can receives, transmit the information along with battery and storing of data.

- Scalability:

- Multi-hop transmission
- Latency:
- Static/Mobile network
- Size
- Price
- Robust to physical environment
- Power consumption
- Low data rate

3. Different Advanced Technologies Used Agriculture

Some of the critical issues related to agriculture field and are can be resolved by newer technologies enlisted below

Technology	Utility
Wireless Sensor Networks	Irrigation Automation & Environment computerization
Remote sensing	Soil moisture, Humidity & rainfall details, Plant Health & Disease monitoring , data acquisition & controlling from the fields
Mobile App technology	Forms water flow regulating, Nutrients feeding ,Form equipment's controlling : CCTV / Energy level monitoring, Automated fire & smoke alarming techniques.

Sensor Motes Used For Agriculture

This below mentioned table shows different sensors available in the market for smart agriculture application.

Sensor Platforms	Sensors	Applications
TelosB	Temperature, Humidity& Light	Sensing light , humidity, temperature & GPS positioning
IRIS	Temperature , Humidity & Soil moisture	Sensing temperature, light & humidity Measuring soil moisture & regulation the flow of water

Sensor Types and Monitoring Parameters

It is known that carbon dioxide and water changes to starch and glucose by using sun light and water as plant food. The nutrients nitrogen, Phosphorus helps in the growth of plants and Potassium helps in photosynthesis, quality of yields and reduces the diseases in the crops.

The fertility of the soil is studied by taking samples from various parts of the identified field and experiments were carried out at laboratory as this is very difficult to the growers to carry out the same at their level as costing is involved and lack of updated technology. These tests includes

- ***Humidity Sensor***

  It is observed that if the plantation has too high or too less moisture, it creates problems in plant. In order to keep the moderate moisture, humidity sensor is used to maintain normal. This will help the formers to monitor the condition of humidity as required by the crop and regulate the same.Wang.et al. [16] reported that TelosB –humidity sensor is device which detects and indicates the required quantum of water vapor present.

- ***CO_2 Sensor***

The required quantity of oxygen level must be there in the root system to keep the system metabolism in nutrition. It is very important that if oxygen comes below the normal, it affects the root respiration system. Thus CO_2 Sensor is employed to overcome this drawback and also to monitor the real-time level. H.Soffer [17] advice to employ CO2 sensor to detect and monitor its level, so as to have healthy plantation.

- ***EC and pH Sensor***

  It is noted that pH and EC level should be moderate and are controlled for preventing of barrier growth. Its measurement is very important since the ion concentration [18]. Solubility of chemicals in the alkaline and acid changes.It is one of the important parameter to be measured and to be regulated fulltime growth of the plant. If the concentration level is abnormal, the rate of absorption of required nutrients also differs and intern results in plant growth

- ***Light Intensity Sensor***

  The smart agriculture refers to the usage of controlled light intensity of the plantation. There are good number of light sensors is available in the markets to detect the light and darkness. They include photo resistor, Photodiodes & photo transistor for varying light intensity. The light sensing devices includes phototransistors and photodiodes. The authors proposed web based system with Internet of Things to handle enormous data's handling system .They used LDR to measure intensity of light. [19].

  The population of India and China crossed 2.9 billion people as on today and 70% of water is being used for agriculture sector. The croplands irrigated is only around 17%, but they account for 40% of the earth. The population is still increasing, the demand of water also rising. The smart usage of water in farming sector is the

only way to compensate the demand of water supply. By adopting smart agriculture system, the wastage of water can be controlled to the maximum extent by at least by 20% [20]

2.3. Realtime Ground Test Results

For this implementation and evaluation of this realtime results , we had created the agricutural environment for observing and monitoring realtime updates.

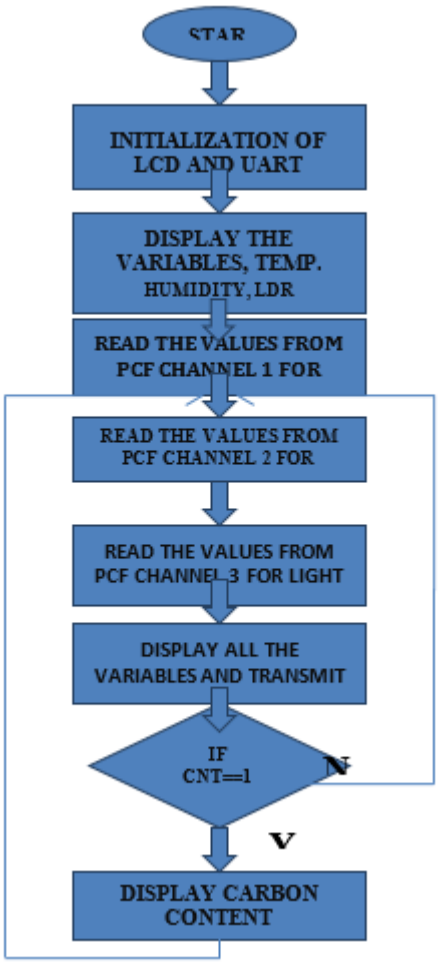

Figure 2. Transmitter Section Design Flow

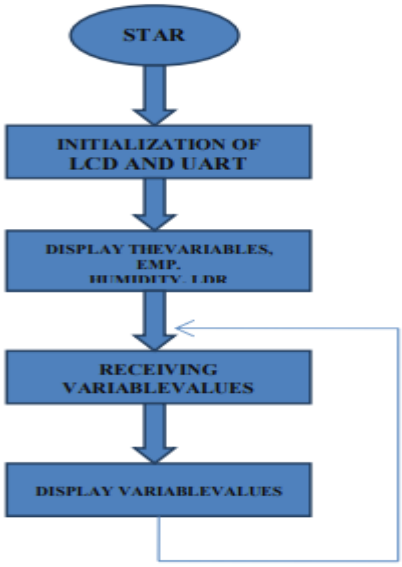

Figure 3. Receiver section design flow

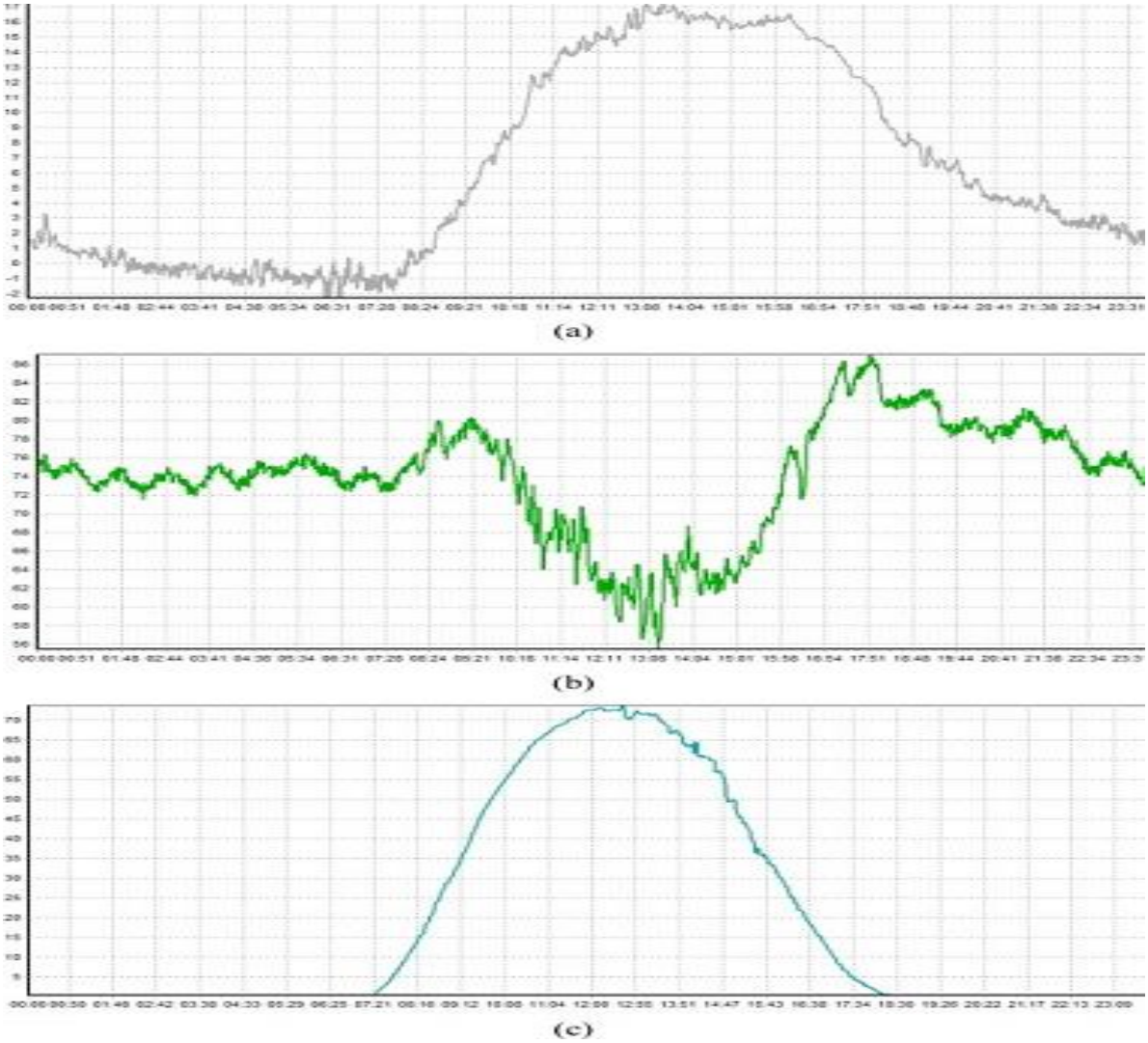

Fig 4. Measured Environmental Data Graph. **(a)** Temperature Graph ; **(b)** Humidity Graph **(c)** Luminance Graph .[Courtesy: Study on an Agricultural Environment Monitoring Server System using Wireless Sensor Network, Sensor , J Hwang, Cashing, H.Yoe-pp 11189-11211]

Figure 4. is a graph that represents environmental data measured by the proposed agricultural environment monitoring server system that is installed to be operational in the real agricultural environment, and it could be seen from this graph that the agricultural environment monitoring server system normally processes information sensed from sensor nodes installed outdoors without malfunction.

4. Conclusion

The cableless , wireless sensor network system is very attractive as its very dynamic in nature. These WSN consists of transeivers with energy storing arrangement & memory segment. Hence this IOT backed WSN is cost effective as it consists of very small sensor nodes. In our work , we focused mainly on temperature , CO2 in precision forming and humidity of the soil . The reliabilty in WSN in agriculture is unproven and is reisky and but very challenging.

5. Future Scope

In the nearby future, this can be updated using data analitics for the study of aquired previous datas , for growing right crops at right time and availability of storage arranegement with best price in the market.The artificial intelligence is playing vital role in developing agriculture sector and also finding solution for improving plantation and productivity. It is expected much higher with faster rate .At present good lot of research work is in progress to cut down the usage of water and sensible usage of other minerals and growing pattern along with cropping

.Moreover, the principal of AI in smart forming is one where intervention of human is relatively reduced and machine takes care of the environment and fertility of the field.

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